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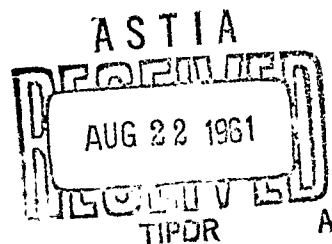
INDUSTRIAL ENGINEERING DIVISION

Lake City Arsenal

PRODUCT ENGINEERING DESIGN STUDY OF

CARTRIDGE, 37MM, SPOTTING, XM415

I. E. D. REPORT NR.61-12



PROJECT: 56-32 4010.15.0106.1.01.62

JULY 1961

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INDUSTRIAL ENGINEERING DIVISION
LAKE CITY ARSENAL
INDEPENDENCE, MISSOURI

PRODUCT ENGINEERING DESIGN STUDY OF
CARTRIDGE, 37MM, SPOTTING, XM415

Industrial Engineering Report
61-12

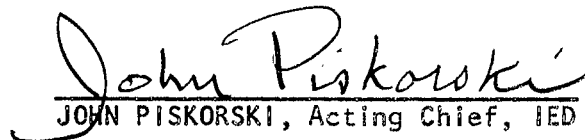
Project Number:
4010.15.0106.1.01.62

JULY 1961

Prepared by:


FRANK W. LITTLEFORD

Approved by:


JOHN PISKORSKI, Acting Chief, IED


GEORGE E. RUPPEL

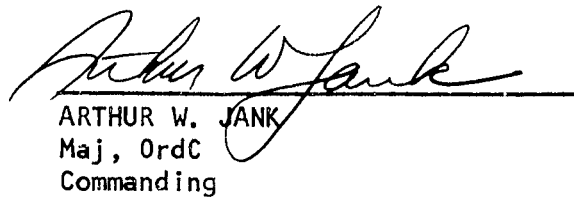

ARTHUR W. JANK
Maj, OrdC
Commanding

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1. ABSTRACT:

This report covers the Industrial Engineering Division, Lake City Arsenal, product engineering design study of Cartridge, 37mm, spotting, XM415, which is a sub-caliber component of the XM29 Weapons System. Experience gained at Lake City Arsenal in the production engineering and initial manufacturing phase of Cartridge, 20mm, spotting, XM101, was fully utilized and applied. Altogether some twenty-one (21) completely dimensioned and annotated component drawings were generated, but no actual metal parts were made or tested.

The modified cartridge case is similar in basic design to the 20mm XM154. Two case plugs of different internal volume fit the case body to provide the two ranges required of the spotter round. The case wall thickness is the minimum which will safely withstand anticipated excess chamber pressure requirements without additional heat-treatment.

The projectile was simplified and improved by changing to a conventional one-piece body with a male threaded fuze intruding into the mouth. The external configuration closely resembles the XM101 projectile but for size; weight and c.g. are unchanged from the Picatinny Arsenal XM415 projectile. Several internal changes were made for simplification of manufacture, assembly, or both, and several

components were eliminated thereby. The counterweight was changed from lead to D-38 which was a major factor in the increase of the payload by 23% over the Picatinny Arsenal projectile.

No assembly drawings other than a sectioned layout were generated during this project, and if desired, will require additional funding.

A study to modify the T336E7 fuze to the XM415 projectile is in progress and will be reported separately.

The subject study was completed in time that changes can be incorporated by Picatinny Arsenal into the R&D and ET-UT quantities if desired.

II. INTRODUCTION:

Because of the experience gained by the Industrial Engineering Division, Lake City Arsenal, in the production engineering and initial production phase of the Cartridge, 20mm, spotting, XM101, this arsenal was funded by Picatinny Arsenal, ORDBB-TW4, to conduct a production engineering design study of the subject cartridge, and supply Picatinny Arsenal with a set of engineering drawings.

The function of the XM415 cartridge is to provide spotting (i.e., direct range determination) information for the XM29 Weapons System. To accomplish this a "Dial-the-Zone" cartridge case was originally designed by Picatinny Arsenal to cover the two ranges of

the major weapon. However, by the time IED began the subject engineering study this "dual-zone" case had been dropped in favor of two separate cartridges, one for each zone.

The XM415 projectile differs from the XM101 in that the spotting mix is ejected rearward and upward, thereby substantially increasing the probability of visual observation under all conditions of weather and terrain. The rear ogive of the XM415 projectile body is opened by a small PETN charge in the front of the tail boom.

After completion of this study, drawings were received from Picatinny Arsenal showing a cartridge case (Drawing AA-44-1666) similar in external configuration to the LCA case generated in this study. The wall section is much thinner and heat-treatment is required for the necessary strength. A case mouth anneal is not indicated. Two case plugs, metering disc and metering disc cover incorporating LCA redesign features, were then made up for the PA case, theorizing that the gun chamber configuration may have been frozen.

Experience with the XM154 case and similar items indicates that warpage caused by heat-treating will substantially increase the inspection rejection rate. The PA case (Drawing AA-44-1666) is 1.6" longer than the LCA case which increases material cost by 15%, plus the alloy costs. The taper of the PA case is substantially less than the LCA design, and increased extraction problems are anticipated thereby.

III. PROCEDURE:

All Picatinny Arsenal component and assembly drawings were studied in detail as to materials used, methods of manufacture required, functioning of each item and assembly, special assembly and inspection techniques required, and general over-all practicality.

During the entire study and subsequent redesign, parameters established by Picatinny Arsenal were closely adhered to.

No actual components were fabricated, the entire operation being a paper study.

Completed component drawings were delivered to Picatinny Arsenal, Messrs. E. Roof and D. Trevarrow, on 13 July 1961, and the various recommended changes from the Picatinny Arsenal design thoroughly discussed.

IV. RESULTS OF STUDY:

A brief resume of changes made, with reasons, to the major components follows:

a. Case Body, Drawing LCA-SK-423

<u>Change</u>	<u>Reason</u>
Increased taper	Better extraction
Standard threading	Lower tooling cost
No heat-treatment	Lower processing cost and rejection rate
Carbon steel	Lower material cost
Reduced over-all length	Material & machining costs reduced
Rimless configuration used	Savings in material and processing realized.

b. Case Plug, Drawing LCA-SK-421 (long range)
LCA-SK-422 (short range)

<u>Change</u>	<u>Reason</u>
Igniter tube eliminated	Improved ignition and decreased velocity dispersion at less cost.
Carbon steel	Lower cost
No heat-treatment	Lower processing cost & rejection rate.
Firing Plug (Dwg. 74-2-78M) eliminated	Firing pin impinges directly on primer. Less cost & more positive action.
Four (4) torque holes are used on the long range plug, two (2) only on the short range plug.	Positive night identification
Counterbore removed from torque hole	Simplified tooling & lower cost.

c. Metering Disc, Drawing LCA-SK-424

<u>Change</u>	<u>Reason</u>
Single size & same number of holes	Reduced tooling & production costs
No trepanning	Lower costs
Fool-proof assembly	Same disc used for both ranges, no chance of mistake in loading.

d. Metering Disc Cover, Drawing LCA-SK-420

<u>Change</u>	<u>Reason</u>
Thickness increased to .005 from .003 used by Picatinny Arsenal	Improve ignition
One cover for both ranges	Simplify production & loading, and reduce costs.

e. Projectile Body, Drawing LCA-SK-446

<u>Change</u>	<u>Reason</u>
Eliminate threaded juncture in center of body	Concentricity requirements cannot be maintained in production. Adapter (PA Dwg. AA-44-1554) eliminated. Improved body security. Improve interior ballistics as body O.D. can be held to closer limits. Improve exterior ballistics as the thread concentricity problem is eliminated.
Moved obturating band rearward	Reduces length of case as projectile intrusion is less. Material and machining costs reduced thereby.
Changed material of the counterweight (P.A. "insert") LCA-SK-443	The volume saved thereby is added to the payload, increasing it by some 23%.
Visual effectiveness increased <div data-bbox="348 932 702 1042" data-label="Text"> <p>Payload Volume: P.A.: 1.567 cu. in. L.C.A.: 1.919 cu. in.</p> </div>	The increased volume (23%) of spotting mix will substantially increase the display. Observation of the projectile under adverse weather and terrain conditions, and in the Arctic, should be greatly improved.
Band seat configuration	A conventional double-undercut band seat was added to assure band security. Obturation is achieved by interference rather than by gas pressure as on the PA projectile. It is believed the PA band will come off causing external ballistic problems.
Band material	Teflon instead of geon is shown as the banding material. Experience with geon in the XM101 program indicates that it scuffs off easily in the barrel and is a cause of velocity dispersion. If teflon is unacceptable, a 10/1 Pb/Sn alloy band is recommended.
Body material	Changed to C-1030-40 steel rather than a "resulphurized" grade, which is subject to seams; causing security problems when fired.

<u>Change</u>	<u>Reason</u>
Simplified charging and loading	Encapsulation of ejection charge eliminated. The black powder is directly loaded into the body during projectile charging & assembly sequence. Ejection charge volume is the same as on the PA projectile and is placed within a steel sleeve which also acts as a support for the counterweight.
External configuration	Much the same as the current XM101 projectile, which closely matches the exterior ballistics of the major round. This configuration also contributes toward increased "payload".
External scoring	Removed internal score marks from critical thread area. Simplified machining.

f. Igniter Tube, Drawing LCA-SK-445

<u>Change</u>	<u>Reason</u>
Simplified configuration THE ORIGINAL DOCUMENT WAS OF POOR QUALITY. BEST POSSIBLE REPRODUCTION FROM COPY FURNISHED ASTIA. /	The rear portion of the tube is flanged outward so it will seat on a shoulder in the tail boom (LCA-SK-444). This eliminates one part (PA AA-44-1250) and a silver soldering operation.
Threads eliminated	As the igniter tube is self-supporting, the retaining nut at front of igniter tube is unnecessary. The counterweight in the counterweight is also eliminated.

g. Tail Boom

<u>Change</u>	<u>Reason</u>
Thread pitch to 24/in	Increased strength
External configuration	Changed to conform to rear of projectile body. This will also permit easier entrance of air into fins.

<u>Change</u>	<u>Reason</u>
Direct charge PETN	Eliminate separate cup and disc, thereby lowering cost by elimination of these parts.
Drill point in PETN cavity	Facilitates production and eases inspection.
Front end configuration	A crimp type configuration was added to the front end to hold igniter tube and facilitate automatic remote handling during assembly operations. Security of boom and igniter tube assembly is increased.

h. Tail, Drawing LCA-SK-447

<u>Change</u>	<u>Reason</u>
Leading edge radius	Change to a "V" edge to facilitate production and inspection.
Leading edge sweepback	Leading edge tilted back 30° to enhance aerodynamics.
Thread pitch to 24/in	Increased strength
Reduced over-all diameter	To minimize concentricity tolerance build up.
* 6 - Fin	Data indicated 6-fin type superior to 4 fins in availability of area to prevent side-draft or yaw.
* Fin caps	Caps act similar to a shroud without as great drag.

- * These changes permitted shortening of fin length thus decreasing cost of expensive extruded material, but will require a length of boom as per LCA-SK-444. Should 4-fin tail (LCA-SK-451) be adopted, boom will need be as per LCA-SK-439.

V. CONCLUSIONS:

It is believed that changes developed by the subject production engineering design study will improve the ballistic reliability and producibility of Cartridge, 37mm, spotting, XM415, without significant change in the required military characteristics, and this at a substantially lesser cost per round.

VI. RECOMMENDATIONS:

It is recommended that:

- a. A small test quantity of the LCA modified Cartridge, 37mm, spotting, XM415 be manufactured for comparative ballistic test at APG.
- b. Funds remaining on this project be expended on a study toward modifying the T336 fuze for use with the subject cartridge.

THE ORIGINAL DOCUMENT WAS OF POOR
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VII. APPENDIX A.

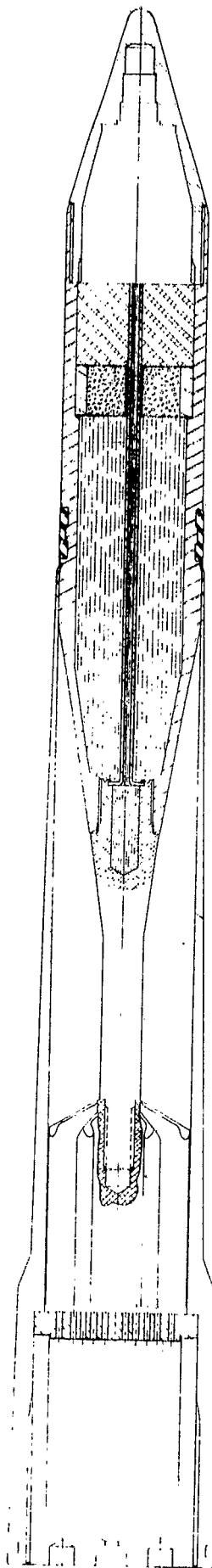
Sketches

LCA-SK-419 through LCA-SK-428

LCA-SK-439 through LCA-SK-451

Unnumbered Sketch (Assembly)

AA-44-1666

[illegible]

PRODUCTION ENGINEERED

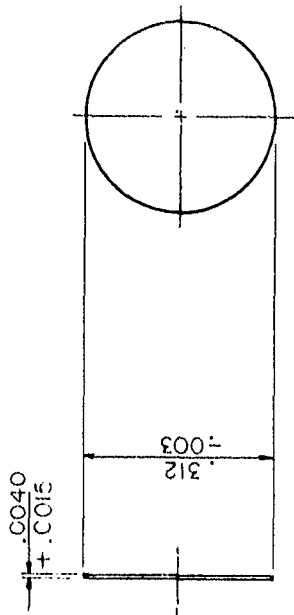
XMA 415

SCALE - 2 1/2"
JUNE 20, 1961

JUNE 20, 1951

REVISIONS

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1 - SPECIFICATIONS MIL-G-2550, MIL-STD-8 AND LCA-PD-11 APPLY.

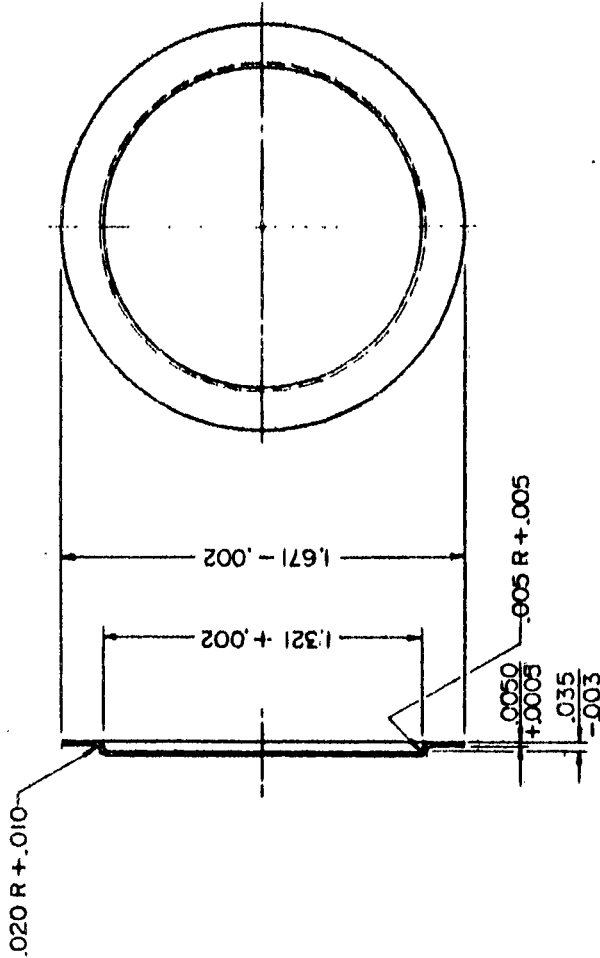
2 - MATERIAL :- PAPER (FOILING), TYPE I OR II, (COLOR, RED), SPEC JAN-P-224, EXCEPT FOR THICKNESS REQUIREMENT.

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B-LCA-SK-420

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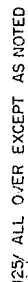
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NOTES :-

- 1 - SPECIFICATIONS MIL-G-2550, MIL-STD-8 AND LCA-PD- APPLY.
- 2 - MATERIAL:- BRASS STRIP, ALLOY #6 ANNEALED, R_{15T} 65-72, ASTM SPEC B 36.
- 3 - DISCOLORATION PERMITTED.

ORDNANCE CORPS DEPT OF THE ARMY LAKE CITY ARSENAL INDEPENDENCE, MISSOURI		LCA-SK-420	
METERING DISCOVER		SCALE 2/1	UNIT WT
ORIGINAL DATE JUN 2, 1961	DESIGNED BY J. H. H. H.	CHECKED BY J. H. H. H.	APPROVED BY J. H. H. H.
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON DECIMALS	MATERIAL NOTE 2		
FINISH-TREATMENT	FINAL PROTECTIVE FINISH		
PHYSICAL PROPERTIES	APPLICATION		
TEMPERATURE	DO NOT APPLY PART NO. 15-SPECIFIED		



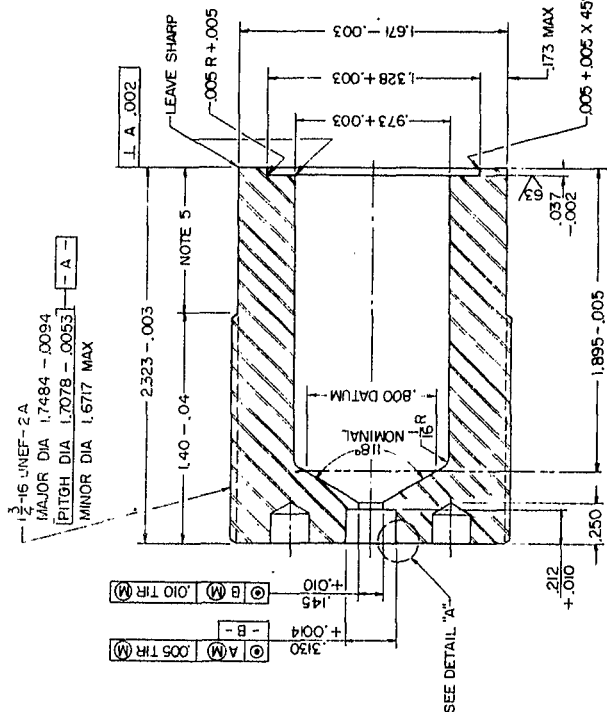
NOTE 4

DETAIL "A"
SCALE: - 50%

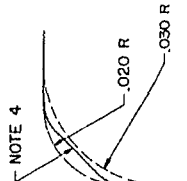
- NOTES:-
- 1 - SPECIFICATIONS MIL-G-2550, MIL-STD - 8, MIL-STD-10 AND LCA-P0- APPLY
 - 2 - MATERIAL- STEEL, BAR, COLO-FINISHED, GRADES 1030 TO 1040, EXCEPT RESULTPURCHSED GRADES, ASTM SPEC A108 GRAIN SIZE 5-8 PER ASTM SPEC E10
 - 3 - ZINC PLATE; CLASS 3, TYPE II, BRASS COLOR, SPEC QQ-Z-325. BAKE AT 375° F FOR 3 HOURS IMMEDIATELY AFTER PLATING.
 - 4 - SHAPE OF ENTRANCE TO PRIMER POCKET MAY VARY PROVIDED ALL SURFACES BLEND SMOOTHLY WITH EACH OTHER AND WITH PRIMER POCKET SIDEWALL AND BASE OF CASE PLUG. ALL SURFACES MUST BE WITHIN THE ZONE FORMED BY A .030 R-.010, TANGENT TO PRIMER POCKET SIDEWALL AND BASE OF CASE PLUG.
 - 5 - THREAD TRACES PERMITTED IN THIS AREA.

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REV	DESCRIPTION	DATE	APPROVAL
1			



125/ ALL OVER EXCEPT AS NOTED



DETAIL "A"
SCALE: 1-50/1

NOTES :-

- 1 - SPECIFICATIONS MIL-G-2550, MIL-STD-8, MIL-STD-10 AND LCA-PD-1 APPLY.
- 2 - MATERIAL: STEEL, BAR, COLD-FINISHED, GRADES 1030 TO 1040, EXCEPT RESULPHURIZED GRADES, ASTM SPEC A108, GRAIN SIZE 5-8 PER ASTM SPEC E19.
- 3 - ZINC PLATE; CLASS 3, TYPE II, BRASS COLOR, SPEC QQ-Z-325, BAKE AT 375° F FOR 3 HOURS IMMEDIATELY AFTER PLATING.
- 4 - SHAPE OF ENTRANCE TO PRIMER POCKET MAY VARY PROVIDED ALL SURFACES BLEND SMOOTHLY WITH EACH OTHER AND WITH PRIMER POCKET SIDEWALL AND BASE OF CASE PLUG. ALL SURFACES MUST BE WITHIN THE ZONE FORMED BY A .030 R - .010, TANGENT TO PRIMER POCKET SIDEWALL AND BASE OF CASE PLUG.
- 5 - THREAD TRACES PERMITTED IN THIS AREA.

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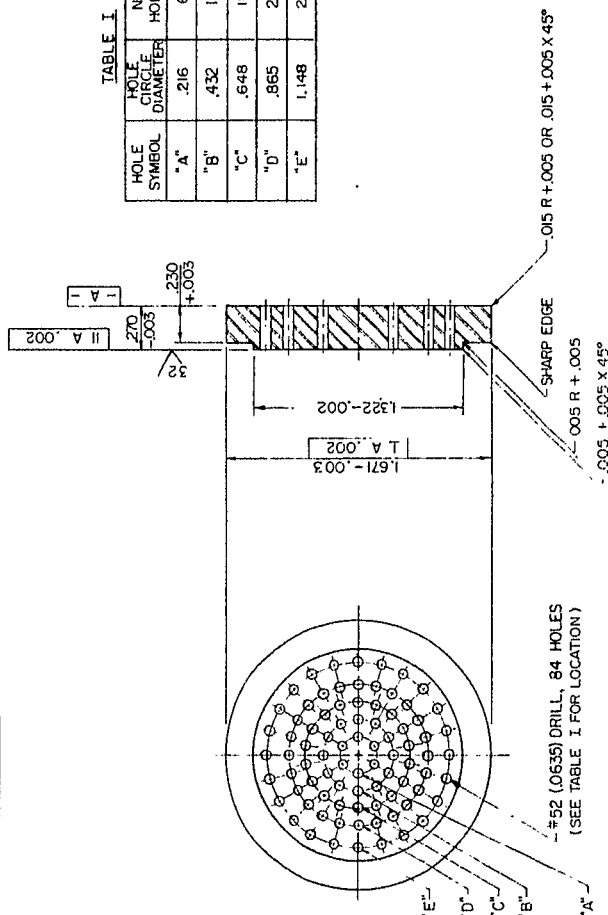
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UNLESS OTHERWISE SPECIFIED		APPROVED BY COMMANDER, THE CORPS		FOR		C	
DIMENSIONS ARE IN INCHES		DRAWN BY		LCA-SK-422		INSET	
FRACTIONS		CHECKED BY		DEPT OF THE ARMY		LAKE CITY ARSENAL	
DECIMALS		APPROVED BY		WINDING, MISSOURI			
ANGLES		SUBMITTED BY					
± 1/64 ± .005 ± "		DATE					
MATERIAL		NOTE 2					
HEAT TREATMENT		NOTE 3					
FINAL PROTECTIVE FINISH		NOTE 4					
NOTE 5							

ORONANCE CORPS
DEPT OF THE ARMY
LAKE CITY ARSENAL
INDEPENDENCE, MISSOURI
C LCA-SK-422

TYPE	REVISIONS	DATE	BY

TABLE I

HOLE SYMBOL	HOLE CIRCLE DIAMETER	NO. HOLES	ANGULAR SPACING
"A"	.216	6	60°
"B"	.432	12	30°
"C"	.648	18	20°
"D"	.865	24	15°
"E"	1.148	24	15°



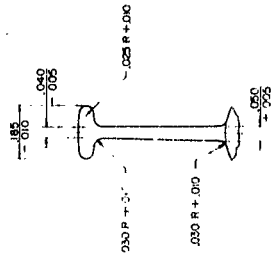
125 / ALL OVER EXCEPT AS NOTED

NOTES:-

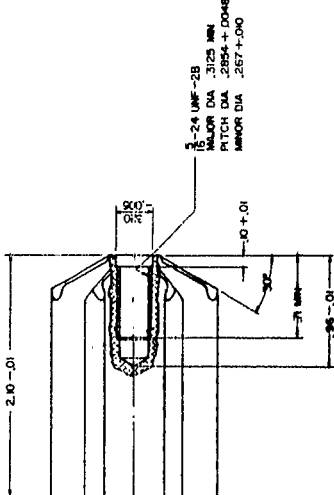
- 1 - SPECIFICATIONS MIL-G-2550, MIL-STD-8, MIL-STD-10 AND LCA-PD- . . APPLY.
- 2 - MATERIAL:- STEEL, BAR, STAINLESS, TYPE 420 OR 420 F, ASTM SPEC A276.
- 3 - GRIND $\frac{32}{1}$ FINISH AFTER DRILLING HOLES.
- 4 - HARDEN AND TEMPER TO ROCKWELL C44 TO C49.

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ORIGINAL DATE OF DRAWING JUN 2, 1961		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		SCALE 2/1	
TOLERANCES ON FRACTIONS DECIMALS ANGLES		TOLERANCES ON FRACTIONS DECIMALS ANGLES		UNIT WT	
MATERIAL NOTE 2		HEAT TREATMENT NOTE 4		APPROVED BY SIGNATURE OF THE	
APPLY PART TO		APPLY PART TO		APPROVED BY SIGNATURE OF THE	

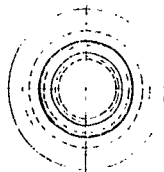


NOTES:-
1 - SPECIFICATIONS MIL-G-2550, MIL-STD-10 AND GAO-PO-APPLY.
2 - FIN STRAIGHTNESS: MAXIMUM DEVIATION FROM STRAIGHT LINE, INCLUDING TWIST, OF ANY EDGE OR SURFACE SHALL NOT EXCEED 0.1" WITH CENTER LINE OF PART.
3 - ALL MACHINED SURFACES SHALL BE FINISHED WITH ADJACENT SURFACES.



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NOTES

1 - SPECIFICATION: MIL-STD-883C-ME, TEST METHOD 2000.1, MECHANICAL SHOCK, 100g, 1/2" DIA., 1/2" DIA.

2 - MATERIAL: ALUMINUM ALLOY 7075-T6, 45°M SPEC E2H

ALTERNATE MATERIALS: ALUMINUM ALLOY 7075-T6, 45°M SPEC B2H

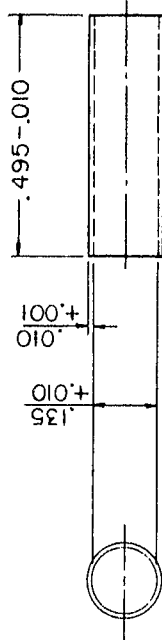
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NOTES:-

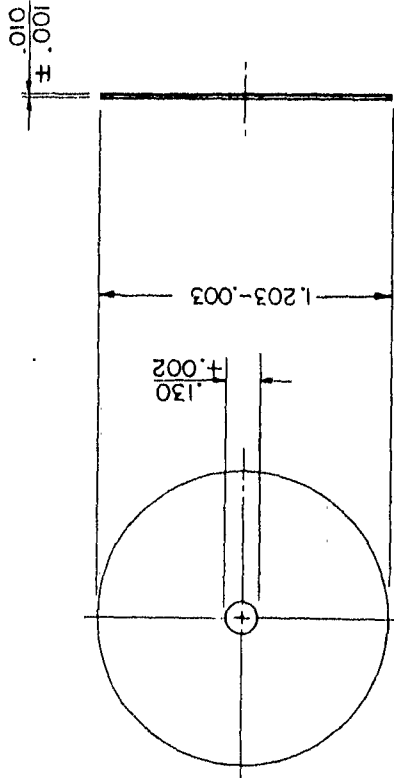
- 1 - SPECIFICATIONS MIL-G-2550, MIL-STD-8 AND LCA-PD- . APPLY.
- 2 - MATERIAL:- PAPER, FOILING, TYPE II, SPEC JAN-P-224.

ORDNANCE CORPS DEPT OF THE ARMY LAKE CITY ARSENAL INDEPENDENCE, MISSOURI		DWG SIZE B		SHEET 02	
		LCA-SK-440			
EJECTION CHARGE SLEEVE (INNER)					
SCALE 4/1		UNIT WT 6 GR APPROX			
ORIGINAL DATE OF DRAWING JUN 14 1961		DRAFTSMAN J. H. HARRIS		CHECKER J. H. HARRIS	
TRACER J. H. HARRIS		SUBMITTED J. H. HARRIS		APPROVED BY ORDER OF THE CHIEF OF ORDNANCE J. H. HARRIS	
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES FRACTIONS DECIMALS ANGLES		MATERIAL NOTE 2		HEAT-TREATMENT	
PHYSICAL PROPERTIES		VP		TS	
EL 2		RA		BH	
RH		RH		RH	
NEXT ASSY		USED ON		APPLICATION	
DO NOT DO		APPLY PART NO.		TS-SPECIFIED	

B-LCA-SK-441

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NOTES :-

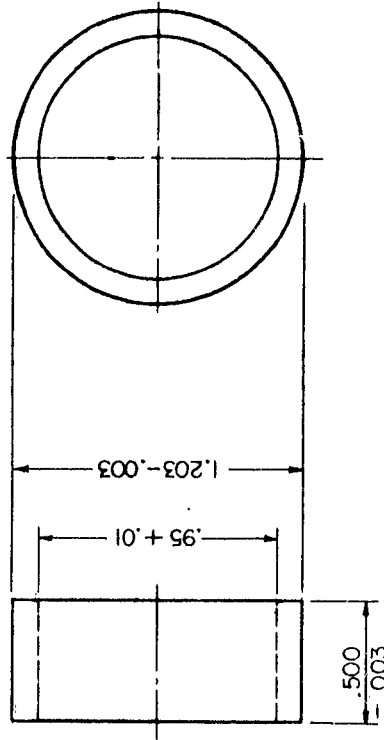
- 1 - SPECIFICATIONS MIL-G-2550, MIL-STD-8 AND LCA-PD-APPLY.
- 2 - MATERIAL: ALUMINUM SHEET, ASTM SPEC B209.

ORDNANCE CORPS DEPT OF THE ARMY LAKE CITY ARSENAL INDEPENDENCE, MISSOURI		LCA-SK-441 SHEET	
EJECTION CHARGE COVER		SCALE 2/1	UNIT WT 7.0 GR ± 1
ORIGINAL DATE JUN 13, 1961	DRAWN BY J. J. P. 100	CHECKED BY J. J. P. 100	APPROVED BY ORDER OF THE CHIEF OF ORDNANCE J. J. P. 100
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES FRACTIONS DECIMALS ANGLES		MATERIAL NOTE 2	
PHYSICAL PROPERTIES TEMPERATURE EL. 2 RA BH RH		HEAT TREATMENT FINAL PROTECTIVE FINISH	
NEXT ASSY APPLICATION		DO NOT DO	
APPLY PART NO. RS SPECIFIED			

B-LCA-SK-442

NOTICE: THIS DRAWING SHALL NOT BE USED NOR REPRODUCED EITHER WHOLLY OR IN PART EXCEPT WHEN AUTHORIZED IN CONNECTION WITH UNITED STATES GOVERNMENT PROCUREMENT.

NOTICE: THIS DRAWING SHALL NOT BE USED NOR REPRODUCED EITHER WHOLLY OR IN PART EXCEPT WHEN AUTHORIZED IN CONNECTION WITH UNITED STATES GOVERNMENT PROCUREMENT.



FINISH ALL OVER 125/

NOTES:-

1. SPECIFICATIONS MIL-G-2550, MIL-STD-8, MIL-STD-10 AND LCA-PD- APPLY.
2. MATERIAL: STEEL, BAR, COLD FINISHED, GRADE C-1020 TO C-1040 INCLUSIVE, ASTM SPEC A108. ALTERNATE MATERIAL: STEEL, TUBE, SEAMLESS, COLD-FINISHED, ASTM SPEC A210.

ORDNANCE PART NO.

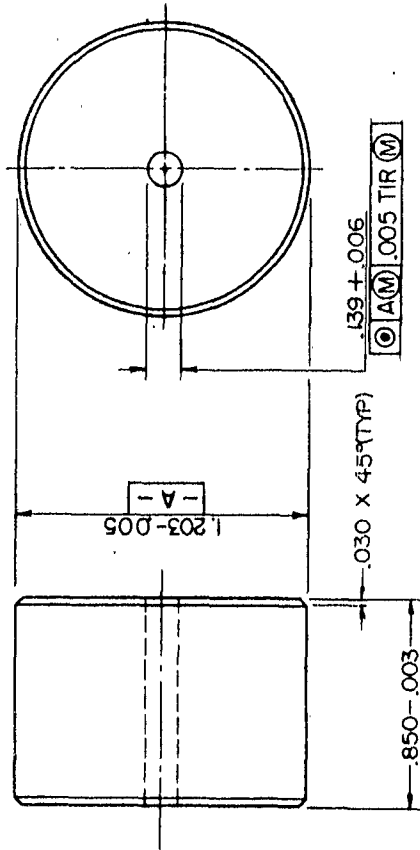
ORDNANCE CORPS DEPT OF THE ARMY LAKE CITY ARSENAL INDEPENDENCE, MISSOURI		DWS SIZE B		LCA-SK-442 SHEET	
SLEEVE		SCALE 2/1		UNIT WT 411.6 GR ± 4	
ORIGINAL DATE OF DRAWING MAY 17, 1961		DRAFTSMAN CHECKER		TRACER CHECKER	
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES FRACTIONS DECIMALS ANGLES ± .005		MATERIAL NOTE 2		HEAT TREATMENT RC 28 TO 34	
PHYSICAL PROPERTIES		TYP		EL 2	
RA		BH		RH	
NEXT ASSY		USED ON		APPLICATION	
DO NOT		APPLY PART NO.		AS SPECIFIED	
APPROVED BY ORDER OF THE CHIEF OF ORDNANCE MAJOR, ORDN CORPS		SUBMITTED FOR REVIEW		APPROVED BY ORDER OF THE CHIEF OF ORDNANCE MAJOR, ORDN CORPS	

BICA-SK-443

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SYN	DESCRIPTION	DATE	APPROVAL

NOTICE THIS DRAWING SHALL NOT BE USED
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EXCEPT WHEN AUTHORIZED IN CONNECTION WITH
UNITED STATES GOVERNMENT PROCUREMENT.



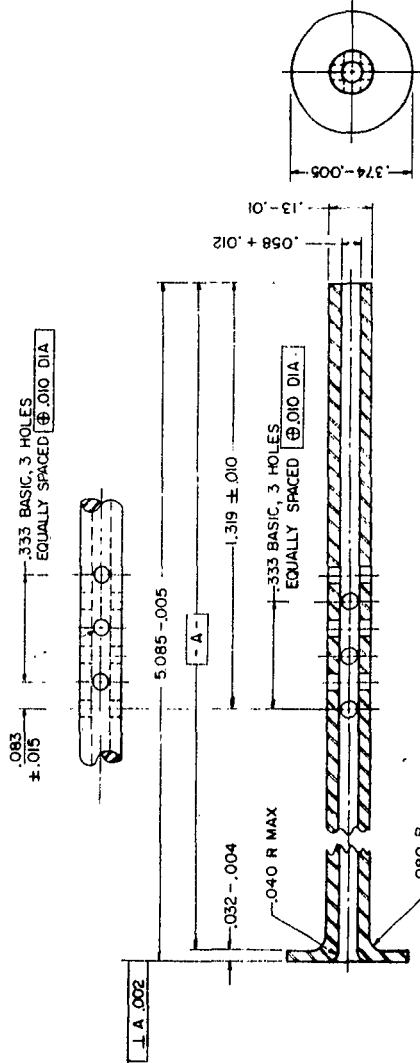
FINISH ALL OVER 125/

NOTES:-

1. SPECIFICATIONS MIL-G-2550, MIL-STD-8, MIL-STD-10 AND LCA-PD APPLY.
2. MATERIAL: D-38 ALLOY, SPEC MIL-U-46045, OR TUNGSTEN ALLOY, SPEC MIL-T-21014.

ORDNANCE CORPS DEPT OF THE ARMY LAKE CITY ARSENAL INDEPENDENCE, MISSOURI		DWG SIZE B		LCA-SK-443 SHEET ONE	
COUNTERWEIGHT				SCALE 2/1	UNIT WT 4283 GR ± 35
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON ANGLES FRACTIONS DECIMALS ±20		ORIGINAL DATE OF DRAWING MAY 17, 1961		DRAFTSMAN TRACER CHECKER	
MATERIAL NOTE 2		SUBMITTED FOR APPROVAL		APPROVED BY ORDER OF THE CHIEF OF ORDNANCE MAJOR, ORN CORPS	
HEAT TREATMENT		APPROVED BY ORDER OF THE CHIEF OF ORDNANCE MAJOR, ORN CORPS		APPROVED BY ORDER OF THE CHIEF OF ORDNANCE MAJOR, ORN CORPS	
FINAL PROTECTIVE FINISH		APPROVED BY ORDER OF THE CHIEF OF ORDNANCE MAJOR, ORN CORPS		APPROVED BY ORDER OF THE CHIEF OF ORDNANCE MAJOR, ORN CORPS	
PHYSICAL PROPERTIES		Y.P.		T.S.	
EL 2		RA		BH	
RH		RH		RH	
NEXT ASSY		USED ON		APPLICATION	
DO NOT DO		APPLY PART NO. IS SPECIFIED		APPLY PART NO. IS SPECIFIED	

55 DRILL (TYP)



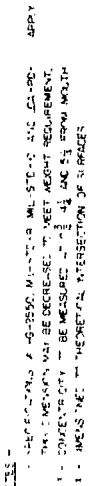
FINISH ALL OVER 125/

NOTES:-

- 1 - SPECIFICATIONS MIL-G-2550, MIL-STD-8
- 2 - MATERIAL:- STAINLESS STEEL TUBING ASTM SPEC A269.

NOTICE THIS DRAWING SHALL NOT BE USED FOR FABRICATING OR TESTING UNLESS IT IS APPROVED BY THE QUALITY CONTROL DIVISION OF THE ARMY. ANY CHANGES TO THIS DRAWING MUST BE AUTHORIZED BY THE QUALITY CONTROL DIVISION OF THE ARMY.

ORDNANCE CORPS DEPT OF THE ARMY LAKE CITY ARSENAL INDEPENDENCE, MISSOURI		C LCA-SK-445 SHEET 1 OF 1	
IGNITER TUBE		SCALE 4/1 UNIT WT 97.3 GR ± 1	
APPROVED BY: <i>[Signature]</i> DATE: MAY 23 1961		APPROVED BY: <i>[Signature]</i> DATE: MAY 23 1961	
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES 1/16 1/32 .010 1/16		MATERIAL: NOTE 2 FINISH: 125/	
PHYSICAL PROPERTIES		MECHANICAL PROPERTIES	
TEMPERATURE RANGE		TENSILE STRENGTH	
YIELD STRENGTH		ELONGATION	
TENSILE STRENGTH		REDUCED SECTION	
ELONGATION		IMPACT	
TENSILE STRENGTH		HARDNESS	
ELONGATION		WELDING	
TENSILE STRENGTH		APPLICATION	
ELONGATION		AS SPECIFIED	



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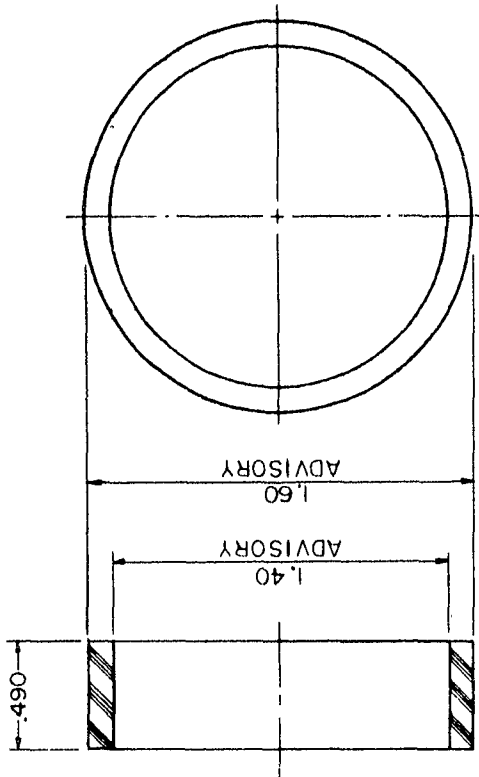
DATE	1968 JUN 1	BY	SP-10
SEE ENGINEERING RECORDS			
NO	1	DATE	1968 JUN 1
NO	2	DATE	1968 JUN 1
NO	3	DATE	1968 JUN 1
NO	4	DATE	1968 JUN 1
NO	5	DATE	1968 JUN 1
NO	6	DATE	1968 JUN 1
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NO	93	DATE	1968 JUN 1
NO	94	DATE	1968 JUN 1
NO	95	DATE	1968 JUN 1
NO	96	DATE	1968 JUN

B-LCA-SK-448

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UNITED STATES GOVERNMENT PROCUREMENT.

REVISIONS		
SYM	DESCRIPTION	DATE
A	MOLDING PLASTIC WAS TEFLON, ADDED ALTERNATE MATERIAL	7-25-61
		APPROVAL



NOTES:-

- 1 - SPECIFICATIONS MIL-G-2550, MIL-STD-8 AND LCA-PD-- APPLY.
 - 2 - MATERIAL:- MOLDING PLASTIC (TFE-FLUOROCARBON RESIN) SPEC MIL-M-14077.
- ALTERNATE MATERIAL:- LEAD TIN ALLOY, ALLOY GRADE 10B, ASTM SPEC B 32.

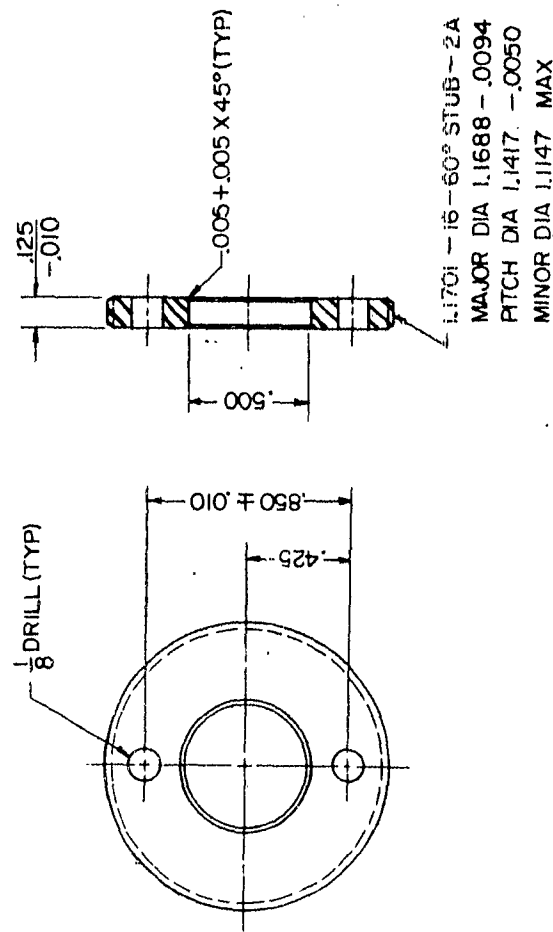
ORDNANCE CORPS DEPT OF THE ARMY LAKE CITY ARSENAL INDEPENDENCE, MISSOURI		DWG SIZE B		LCA-SK-448 SHEET OF	
OBTURATING BAND BLANK				SCALE 2/1	UNIT WT 128 GR APPROX
ORIGINAL DATE OF DRAWING JUN 5, 1961		DRAWN BY CHECKER		APPROVED BY ORDER OF THE CHIEF OF ORDNANCE MAJOR, ORDN CORPS	
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES FRACTIONS DECIMALS ANGLES TOLERANCES ON MATERIAL NOTE 2 HEAT-TREATMENT FINAL PROTECTIVE FINISH		TRACER CHECKER SUBMITTED		APPROVED BY ORDER OF THE CHIEF OF ORDNANCE MAJOR, ORDN CORPS	
PHYSICAL PROPERTIES		NEXT ASSY		USED ON	
VP		APPLICATION		DO NOT	
TE		APPLY PART NO.		AS SPECIFIED	
EL 2					
RA					
BH					
RH					

B-LCA-SK-449

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EXCEPT WHEN AUTHORIZED IN CONNECTION WITH
UNITED STATES GOVERNMENT PROCUREMENT.

SYN	DESCRIPTION	DATE	APPROVAL



NOTES:-

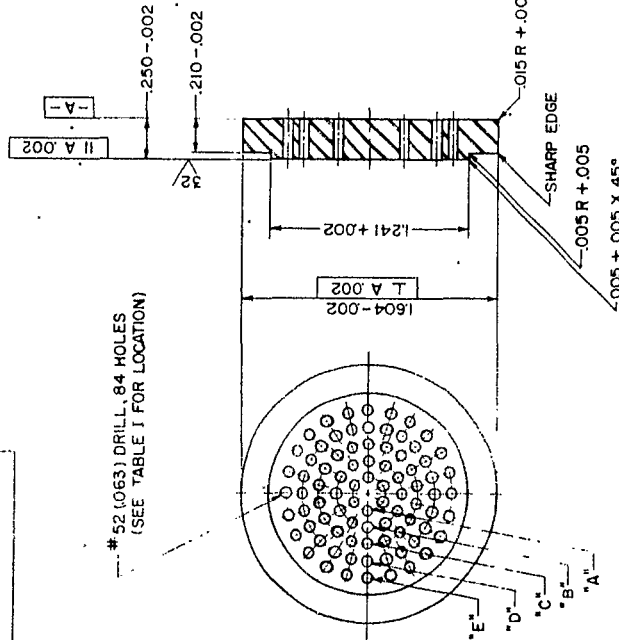
- 1 - SPECIFICATIONS MIL-G-2550, MIL-STD-8
- 2 - MATERIAL: STEEL, BAR, COLD-FINISHED, GRADES C 1030 TO C1040, ASTM SPEC A 108. GRAIN SIZE 5-8 PER ASTM SPEC E 19.
- 3 - ZINC PLATE; CLASS 3, TYPE II, SPEC QQ-Z-325: BRASS COLOR.

ORDNANCE CORPS DEPT OF THE ARMY LAKE CITY ARSENAL INDEPENDENCE, MISSOURI		LCA-SK-449	
DRAWING SIZE B		SHEET	
RETAI ^{NER}		SCALE 2/1	UNIT WT
ORIGINAL DATE JUN 9 1961	DRAWING CHECKER	SUBMITTED	
TRACER	CHECKER	APPROVED BY ORDER OF THE CHIEF OF ORDNANCE Charles E. Ramsey MAJOR, ORDN CORPS	
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES FRACTIONS DECIMALS ANGLES ± 1/64 ± .005 ± 2°	MATERIAL NOTE 2	HEAT TREATMENT	
FINAL PROTECTIVE FINISH NOTE 3			
PHYSICAL PROPERTIES			
YP			
TS			
EL 2			
RA			
BH			
APPLICATION			
DO NOT DO			

C LCA-SK-425

REV	DESCRIPTION	DATE	BY
1			

HOLE SYMBOL	HOLE CIRCLE DIAMETER	NO. HOLES	ANGULAR SPACING
"A"	.207	6	60°
"B"	.414	12	30°
"C"	.621	18	20°
"D"	.828	24	15°
"E"	1.035	24	15°



125/ ALL OVER EXCEPT AS NOTED.

NOTES:-

1. SPECIFICATIONS MIL-2550, MIL-STD-8, MIL-STD-10 AND LCA-PD--X APPLY.
2. MATERIAL:- STEEL, SAH, STAINLESS, TYPE 420 OR 420F, ASTM SPEC A276.
3. GRIND 32/ FINISH AFTER DRILLING HOLES.
4. HARDEN AND TEMPER TO ROCKWELL C44 TO C49.

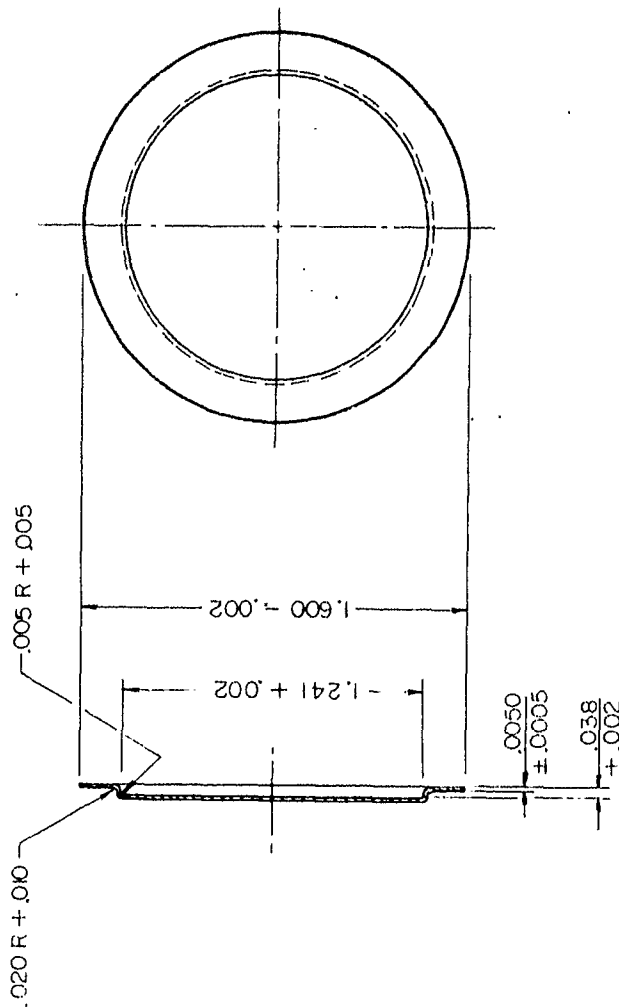
NOTICE THIS DRAWING SHALL NOT BE USED FOR REPRODUCTION EITHER WHOLLY OR IN PART EXCEPT WHEN AUTHORIZED IN CONNECTION WITH UNITED STATES GOVERNMENT PROCUREMENT.

ORDNANCE CORPS DEPT OF THE ARMY LAKE CITY ARSENAL INDEPENDENCE, MISSOURI		C LCA-SK-425	
METERING DISC FOR P.A. CASE AA-44-1666		C	
ORIGINAL DATE OF DRAWING JUN 5, 1961	SCALE 2/1	UNIT WT	
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES FRACTIONS DECIMALS ANGLES 1/16 1/32 1/64 1/8 1/4 1/2 3/4 1 1 1/2 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100	NOTE 2	NOTE 4	
MATERIAL		HEAT TREATMENT	FINISH
APPLY PART NO.		APPLY PART NO.	APPLY PART NO.

B-LCA-SK-426

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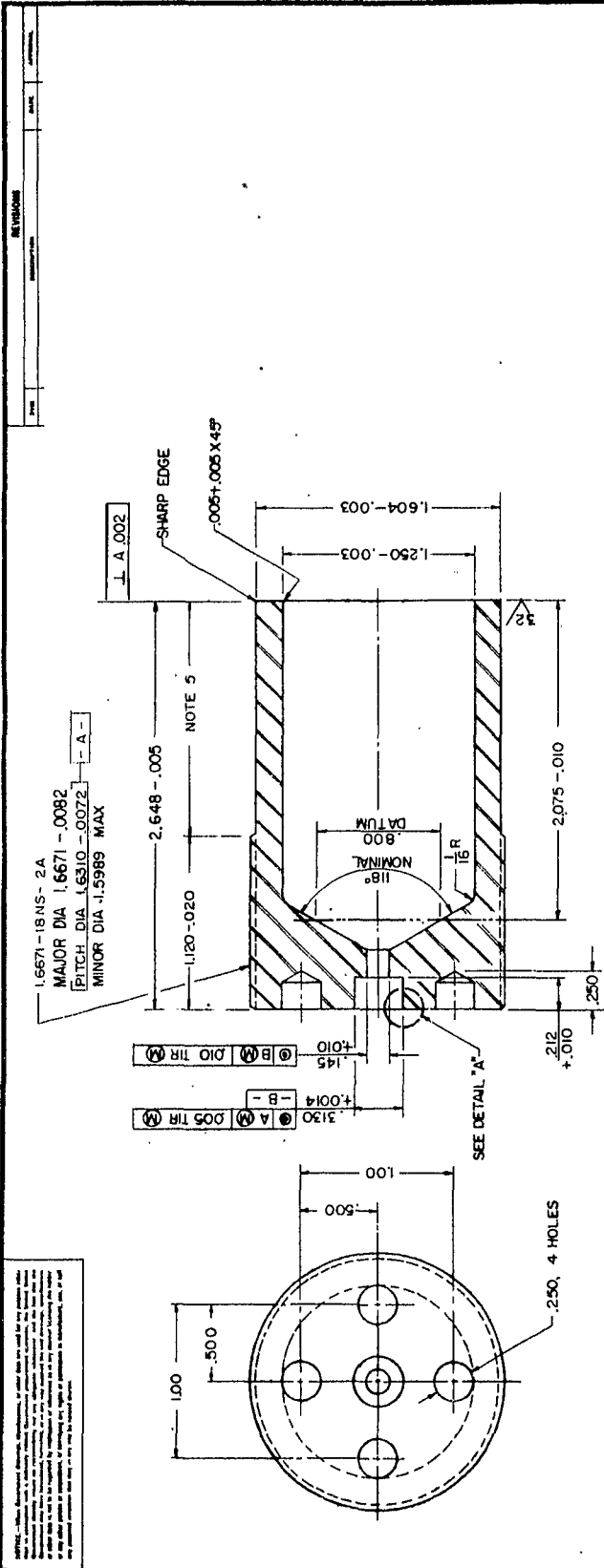
NOTICE THIS DRAWING SHALL NOT BE USED
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UNITED STATES GOVERNMENT PROCUREMENT.



NOTES

- 1 - SPECIFICATIONS MIL-G-2550, MIL-STD-9 AND LCA-PD- APPLY.
- 2 - MATERIAL - BRASS STRIP, ALLOY #6 ANNEALED, R15T 65-72, ASTM SPEC B 36
- 3 - DISCOLORATION PERMITTED.

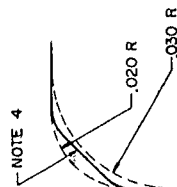
ORDNANCE CORPS DEPT OF THE ARMY LAKE CITY ARSENAL INDEPENDENCE, MISSOURI		DRAWING SIZE B		SHEET OF LCA-SK-426	
METERING DISC COVER FOR P. A. CASE AA-44-1666					
SCALE 2/1		UNIT WT			
ORIGINAL DATE OF DRAWING JUL 5, 1961		DRAFTSMAN J. J. J.		CHECKER J. J. J.	
TRACKER J. J. J.		SUBMITTED J. J. J.		APPROVED BY ORDER OF THE CHIEF OF ORDNANCE J. J. J.	
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES FRACTIONS DECIMALS ANGLES		MATERIAL NOTE 2		TEXT-TREATMENT	
PHYSICAL PROPERTIES		NEXT ASSY		USED ON	
APPLICATION		DO NOT DO		APPLY PART NO. AS SPECIFIED	



125/ALL OVER EXCEPT AS NOTED

NOTES:-

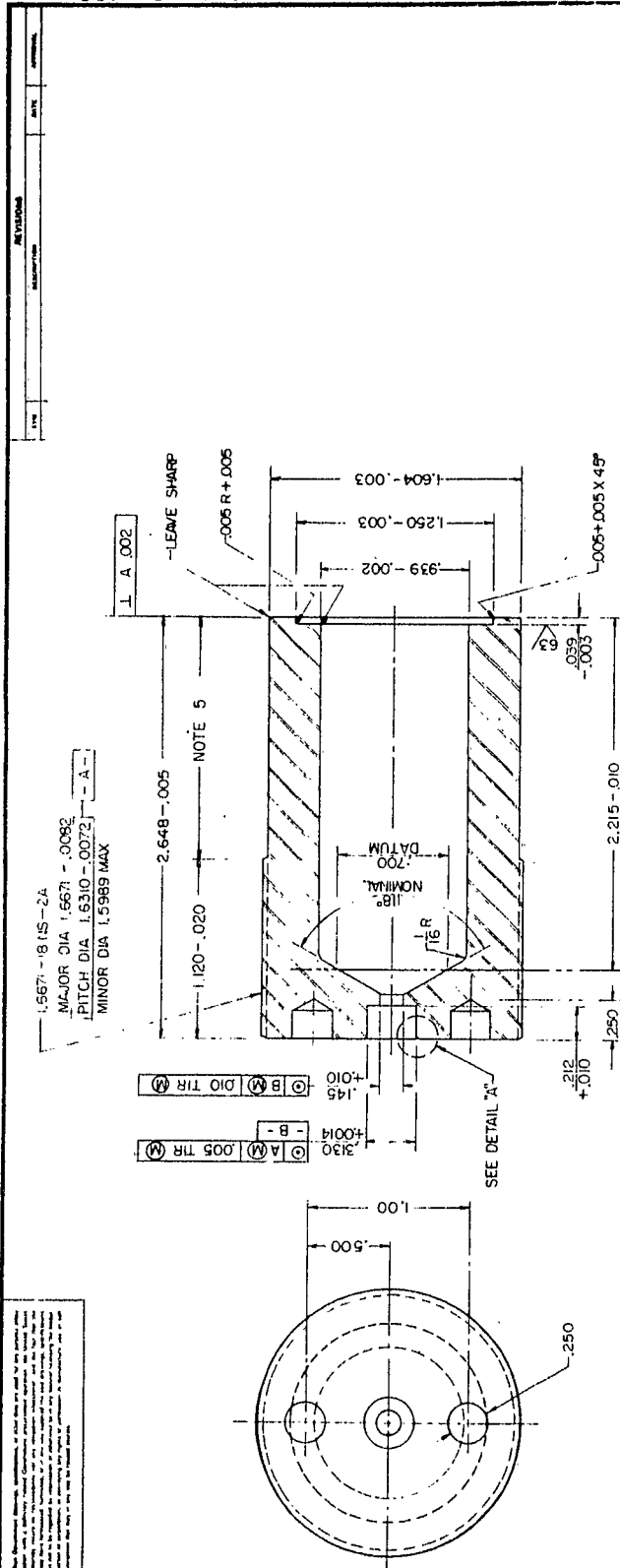
- 1- SPECIFICATIONS MIL-G-2550, MIL-STD-8, MIL-STD-10 AND LCA-PD-1, APPLY.
- 2- MATERIAL:- STEEL, BAR, COLD-FINISHED, GRADES 1030 TO 1040, EXCEPT RESULPHURIZED GRADES, ASTM SPEC A108, GRAIN SIZE 5-8 PER ASTM SPEC E19.
- 3- ZINC PLATE; CLASS 3, TYPE II, BRASS COLOR, SPEC QQ-Z-325. BAKE AT 375° F FOR 3 HOURS IMMEDIATELY AFTER PLATING.
- 4- SHAPE OF ENTRANCE TO PRIMER POCKET MAY VARY PROVIDED ALL SURFACES BLEND SMOOTHLY WITH EACH OTHER AND WITH PRIMER POCKET SIDEWALL AND BASE OF CASE PLUG. ALL SURFACES MUST BE WITHIN THE ZONE FORMED BY A .030 R-.010, TANGENT TO PRIMER POCKET SIDEWALL AND BASE OF CASE PLUG.
- 5- THREAD TRACES PERMITTED IN THIS AREA.



DETAIL "A"
SCALE: 50/1

ORDNANCE CORPS DEPT OF THE ARMY LAKE CITY ARSENAL INDEPENDENCE, MISSOURI		C LCA-SK-427 SHEET	
CASE PLUG (EXTREME RANGE)		FOR P.A. CASE AA-44-1666	
ORIGINAL DATE OF DRAWING JUL 5, 1961	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FINALS ANGLES ±1/4° ±.005	APPROVED BY SUBMITTED BY	DATE
PHYSICAL PROPERTIES	MATERIAL	TEST METHOD	NOTE 3
TEMPERATURE	FINISH	APPLY PART NO.	NOTE 2
STRENGTH	APPLY PART NO.	APPLY PART NO.	NOTE 1
WEIGHT	APPLY PART NO.	APPLY PART NO.	NOTE 4

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EXCEPT UNDER AUTHORITY OF THE
UNITED STATES GOVERNMENT PROCUREMENT.

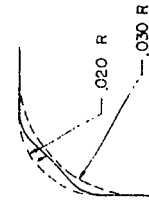


125/ ALL OVER EXCEPT AS NOTED

NOTES:-

1. SPECIFICATIONS MIL-G-2550, MIL-STD-8, MIL-STD-10 AND LCA-PD-1. APPLY.
2. MATERIAL: STEEL, BAR, COLD-FINISHED, GRADES 1030 TO 1040, EXCEPT RESULPHURIZED GRADES, ASTM SPEC A108, GRAIN SIZE 5-8 PER ASTM SPEC E19.
3. ZINC PLATE; CLASS 3, TYPE II, BRASS COLOR, SPEC QQ-Z-325, BAKE AT 375°F FOR 3 HOURS IMMEDIATELY AFTER PLATING.
4. SHAPE OF ENTRANCE TO PRIMER POCKET MAY VARY PROVIDED ALL SURFACES BLEND SMOOTHLY WITH EACH OTHER AND WITH PRIMER POCKET SIDEWALL AND BASE OF CASE PLUG. ALL SURFACES MUST BE WITHIN THE ZONE FORMED BY A .030R-010, TANGENT TO PRIMER POCKET SIDEWALL AND BASE OF CASE PLUG.
5. THREAD TRACES PERMITTED IN THIS AREA.

- NOTE 4

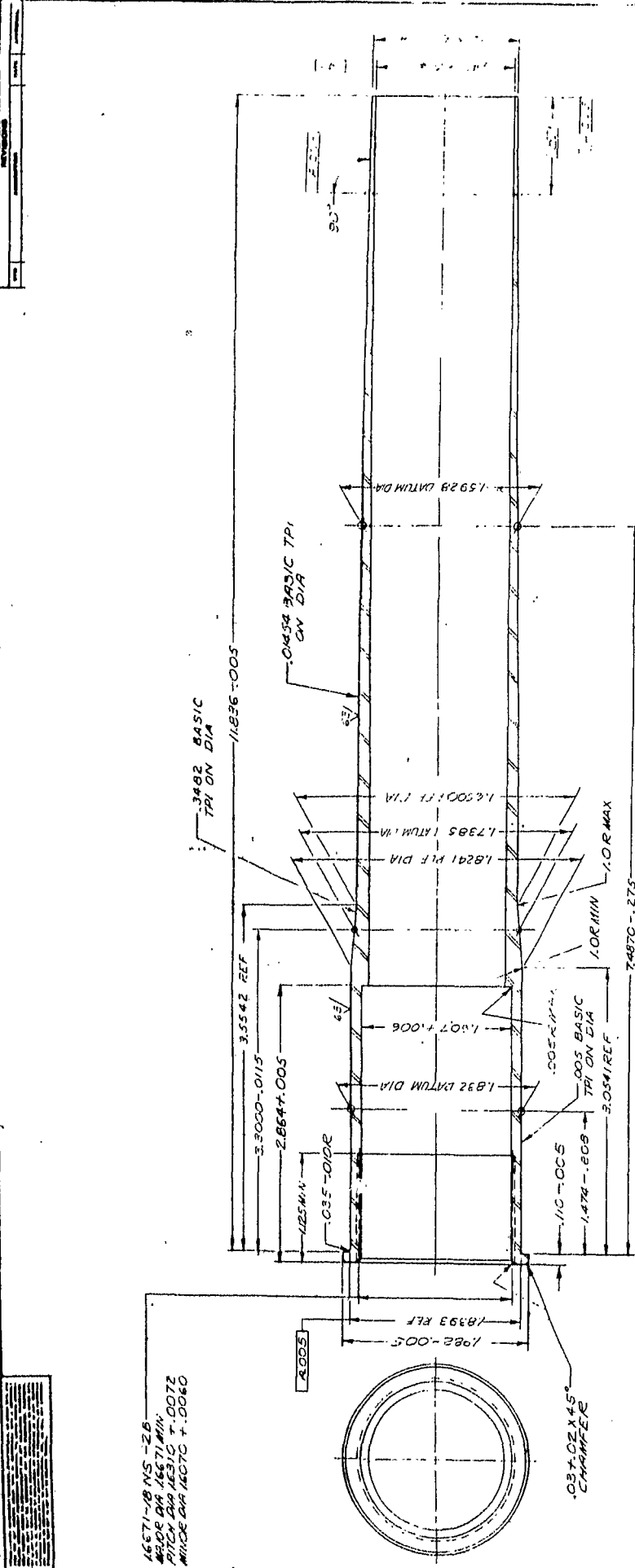


DETAIL "A"
SCALE: 50/1

ORDNANCE CORPS DEPT OF THE ARMY LAKE CITY ARSENAL INDEPENDENCE, MISSOURI		CASE PLUG (SHORT RANGE) FOR P.A. CASE AA-44-1666		C LCA-SK-428	
ORIGINAL DATE JUL 5, 1961		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES FRACTIONS DECIMALS ANGLES ± 1/64 ± .005 ± 1°		SCALE 2/1	
APPROVED BY J. M. G. G. G.		MATERIAL STEEL		UNIT WT	
APPROVED BY J. M. G. G. G.		TREATMENT ZINC PLATE		SCALE 2/1	
APPROVED BY J. M. G. G. G.		FINISH ZINC PLATE		SCALE 2/1	

NOTICE: THIS DRAWING SHALL NOT BE USED FOR REPRODUCTION OR IN PART WITHOUT THE WRITTEN PERMISSION OF THE UNITED STATES GOVERNMENT.

D AA-44-1566



NOTES:-
 1- SPEC MIL-G-2550, MIL-STD-8, MIL-STD-9, MIL-STD-10 AND DWS 30-1-7 APPLY.
 2- MATERIAL IS STEEL, TYPE 304, SEAMLESS, HOT-FINISHED. (SEE NOTE 5)
 3- ALL DIMENSIONS ARE TO BE TAKEN FROM THE CENTERLINE OF THE TAPERED PORTION.
 4- PROTECTIVE FINISH IS TO BE APPLIED TO THE ENTIRE SURFACE.
 5- APPROVED SOURCE - A BUREAU OF THE ARMY, WASHINGTON, D.C. 20315.
 6- THE SOURCE MUST COMPLY WITH THE REQUIREMENTS OF THE MANUFACTURERS
 7- ALTERNATIVE FINISH - FINISH NO. 112.5 OF MIL-STD-17.

ORDNANCE CORPS DEPT OF THE ARMY		SCALE 2/1	
10		DATE 1/1/54	
DRAWN BY: [Signature]		CHECKED BY: [Signature]	
DESIGNED BY: [Signature]		APPROVED BY: [Signature]	
MATERIAL: [Blank]		FINISH: [Blank]	
TOLERANCES: [Blank]		SURFACE FINISH: [Blank]	
MATERIAL SPECIFICATION: [Blank]		MATERIAL SOURCE: [Blank]	
MATERIAL GRADE: [Blank]		MATERIAL QUANTITY: [Blank]	
MATERIAL WEIGHT: [Blank]		MATERIAL VALUE: [Blank]	
MATERIAL LOCATION: [Blank]		MATERIAL STATUS: [Blank]	
MATERIAL HISTORY: [Blank]		MATERIAL COMMENTS: [Blank]	

VII. APPENDIX B

References

APPENDIX B (1)
ORDNANCE CORPS
PICATINNY ARSENAL
DOVER, NEW JERSEY

IE
Mr RDecker/vjt/72205

IN REPLY
REFER TO:

APR 7 '61

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SUBJECT: Cartridge, XM415E3.

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ATTN: ORDCM-IE, Mr. J. Piskorski
Independence, Missouri

1. It is requested that your Arsenal conduct a production engineering study of subject Cartridge and recommend any changes leading to reduction of manufacturing costs, broadening of supply base, improving reproducibility, or reduction of acceptance inspection costs while maintaining high assurance of conformance to design. Monthly reports, due at this Arsenal by the 5th. day following the reporting period, and a final report, due by 30 June 1961, are required with the study.

2. A set of photo prints covering subject Cartridge was furnished to Mr. F. W. Littleford, of your Arsenal, on 16 March 1961.

3. Funding of \$6,000.00 is being forwarded to your Arsenal for the above study.

FOR THE COMMANDER:

cc: Ord Wpns Comd
ATTN: Major Rodgers

D. Trevor Brow
D. TREVOR BROW
Deputy Director
for Army Ammunition

WORK ORDER

1. TO: Ordnance Ammo Command (Lake City Arsenal) ORDLI-AM		2. TO:		3. DATE 11 April 61
FROM: Commanding Officer Picatinny Arsenal, Dover, N.J.		FROM:		4. DOCUMENT CONT. NUMBER 1.02.024.010.010.0
5. OMS CODE AND TITLE 4010.15.0033.2.00.54 XM28 and XM29 Weapons System	7. ELEMENTS	A. QUANTITY UNIT:	B. UNIT PRICE	C. TOTAL COST
	PRIOR			10,000
	INCREASE			6,000
	DECREASE			
6. APPROPRIATE ACCOUNTING CLASS. OF FUNDS (TO BE) MADE AVAILABLE 21 X2030 105-3115 P4011 S/23-012	CURRENT			16,000
	TOLERANCE			
	8. PERFORMANCE OF THE FOLLOWING WORK IS AUTHORIZED (SUBJECT TO AVAILABILITY OF FUNDS) The purpose of this AOS-20 is to provide additional authority for the following. To conduct production engineering study on Cartridge XM415E3. Reference: Letter from PA to LCA dated 7 Apr 61. Subject: Cartridge XM415E3, signed D. Trevarrow. THE ORIGINAL DOCUMENT WAS OF POOR QUALITY. BEST POSSIBLE REPRODUCTION FROM COPY FURNISHED ASSISTANT			
9. DELIVERY SCHEDULE AND INSTRUCTIONS Activity of this order must be initiated on or before 17 April 1961 and all activity must be completed on or before 30 June 1961.				
10. ENCLOSURES None				
FOR USE BY ADDRESSEE		11. AUTHORIZED BY		
12. CONTRACT ACTIONS A. DATE B. NUMBER C. AMOUNT		ORDBB-TP-2 E. Ruben 13 April 1961 TYPED NAME & TITLE SIGNATURE AND DATE		

VII. APPENDIX C

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VII. APPENDIX C
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